

# Development of Learning Devices Through Problem Based Learning Models (PBM) to Improve Problem Solving Ability Students SMP Negeri 5 Stabat

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## Abstract

This study aims to determine: 1) The effectiveness of the learning process by using learning tools of PBM model; 2) improvement of problem solving ability of students by using learning tool of PBM model. This research is a development research with Dick and Carey model. Trial I conducted on the students of class VIII-2 and trial II in class VIII-3 SMP Negeri 5 Stabat. The instrument of this research is observation sheet of student activity, teacher ability to manage learning, student response questionnaire and problem solving test. The problem solving test is valid with the reliability coefficient = 0.829. From the research result, it is found that: 1) the developed device has fulfilled the effectiveness of the learning process; 2) there was an average increase in problem solving ability of students in post test I that is 68.15 increased to 85.19 in trial II.

**Keywords:** Learning Device Development, Learning Approach Model PBM, Problem Solving Ability

## 1. Introduction

Mathematics is one of the subjects taught at every level of education, starting from early childhood education to the level of Higher Education. Mathematics is also the science that underlies the development of science and technology, so that mathematics is seen as a structured and integrated science, the study of patterns and relationships, and the science of thinking to understand the world around. Cornelius (Abdurrahman, 2012: 204) suggests five reasons for studying math because math is (1) a means to think clearly and logically, (2) the means to solve the problems of everyday life, (3) the means to know the relationship patterns and generalizations experience, (4) the means to develop creativity, and (5) a means to increase awareness of cultural development.

Learning by using mathematics is an important aspect of the whole subjects in school (NCTM 2000). One of the abilities that students must achieve in learning mathematics, namely problem-solving abilities (NCTM 2000). So Problem solving is part of a very important mathematics curriculum because in the learning process and problem solving, students are enabled to gain experience using the knowledge and skills they already have to apply to problem solving. The most common problem solving is defined as an experiment to achieve some results, in the absence of known methods to achieve them (Schoenfeld 2013).

But the reality of the field shows that, students have not been able to solve the problem well that causes mathematics learning outcomes have not met expectations. Based on observations made by researchers at SMP Negeri 5 Stabat, showed that students' mathematical problem solving ability is still weak. Such circumstances must be overcome by familiarizing and training students to solve class problem solving problems, activities that include problem solving solutions according to Ruseffendi (1991), namely: (1) to formulate the problem clearly; (2) restates in a form that can be completed; (3) to prepare hypotheses and settlement strategies; (4) implementing the settlement procedure; (5) carry out an evaluation of the settlement.

According to Polya (1973) there are four stages in problem solving: First, we have to understand the problem; we have to see clearly what is required. Second, we have to see how the various items are connected, how the unknown is linked to the data, in order to obtain the idea of the solution, to make a plan. Third, we carry out our plan. Fourth, we look back at the completed solution, we review and discuss it.

From the findings in the field, the low ability of problem solving of mathematical students is caused by several factors, among others: first, the teacher's learning plan is not in accordance with the criteria of development of good learning tools. The existing learning plan is only as a complement to the administration, the teacher does not develop his own learning plan, the learning process seems situational and not directed. This leads to passive and less motivated students in learning. Secondly, students do not have student activity sheets or often called LKS so that the development process of problem solving ability of mathematics is not well developed. Thirdly, the problems presented in the instructional learning book used have not been able to measure the ability of mathematical problem solving in accordance with the expected indicators. Fourth, the teacher's learning ability test is still lacking in the development of problem solving ability of mathematics. From some of the above factors, learning tools become the dominant factor of low students' mathematical problem solving abilities.

In order to develop the problem solving ability of mathematics, a supporting learning device is needed. Starting from that, it is a challenge for teachers to be able to develop their own learning tools. Government Regulation No. 19 of 2005 relating to national standards of education implies that teachers are expected to

develop lesson plans, which are then reinforced through Permendiknas Number 41 of 2007 on process standards. To meet the standards of the process, the learning must be planned, assessed, and supervised.

Ibrahim (Trianto 2011) suggests that learning tools are the tools needed and used in managing the teaching and learning process. The learning tools can be Student Handbook (BS), syllabus, Learning Implementation Plan (RPP), Student Activity Sheet (LKS), evaluation instrument or learning result test, and instructional media. The importance of learning tools in the learning activities so that its development is a very demanded to every teacher and prospective teachers.

RPP developed by teachers must have high validity, high RPP validity criteria according to RPP assessment guidelines (Akbar 2013). The development of good textbooks must meet valid and effective criteria according to Akbar (2013).

Problem-based learning model is a learning model in which learners do authentic problems so that learners can develop their own knowledge, develop high skill and inquiry, develop students, and increase their confidence Trianto (2011). Problem-based learning involves the presentation of authentic and meaningful situations that serve as a foundation for student investigation and inquiry (Arends 2008).

According to Akbar (2013: 34) good textbooks are: (1) accurate (accuracy); (2) appropriate (relevance); (3) communicative; (4) complete and systematic; (5) oriented to student centered; (6) side with the ideology of nation and state; (7) correct language rules, textbooks written using spelling, exact terms and sentence structure; (8) readable, textbooks with high legibility contain sentence length and sentence structure according to reader's comprehension.

Textbooks used in SMP Negeri 5 Stabat still have several weaknesses, among others: first, the material presented in the textbook of students is not in accordance with the objectives of learning to be achieved. Second, directly gives the formula which is then used in problem solving, the textbook does not contain steps in finding the formula so that students only memorize which causes easy to forget in its use. Thirdly, examples of problems do not show steps that can measure the ability to solve mathematical problems.

The importance of the role of LKS as one of the learning tools that support the textbook of students has not been utilized in learning in SMP Negeri 5 Stabat. Because, students do not have LKS as a companion textbook students, this became one of the factors of poorly trained students in honing his mathematical skills. For that teachers are expected to develop LKS that support textbooks as well as students' math skills. The developed LKS must have valid and effective criteria to achieve the expected objectives.

The development of learning device in this research among others, learning implementation plan (RPP), student book (BS), student activity sheet (LKS) should refer to a learning model for the developed tool into a unified complementary and focused on the objectives to be achieved .

Exposure to learning models and the weaknesses of learning tools in SMP Negeri 5 Stabat indicate that the quality of learning device available is not yet quite good. Therefore, it is necessary to develop a quality learning device, in accordance with the conditions and characteristics of students of SMP Negeri 5 Stabat. The quality of the developed device is designed to meet the valid and effective criteria and in accordance with the applicable curriculum. The developed learning device are based on the problem-based learning model, including: Learning Implementation Plan (RPP), Student Book (BS), Student Activity Sheet (LKS) and Problem Solving Tests (TKPM).

Based on the description above, then the problems studied on the formulation of this problem are:

1. How is the validity and effectiveness of learning-oriented model of Problem-Based Learning Model developed on the material of flat-side room in Grade VIII SMP Negeri 5 Stabat?
2. How to improve the problem solving skills of mathematic students of SMP Negeri 5 Stabat on the material of building flat side room using learning device with problem-based learning model?

## 2. Research Methods

The development of the device used in this study is to use the Dick & Carey model development procedure for several reasons: the Dick & Carey model has been widely used to develop effective tools, every step of the Dick & Carey model is feedback or revised, Dick & Carey's model is very concise, compact and clear and interconnected with each other and in accordance with the applicable curriculum. The module development procedure with Dick & Carey's development model can be described as follows Dick *et al.* (2005):

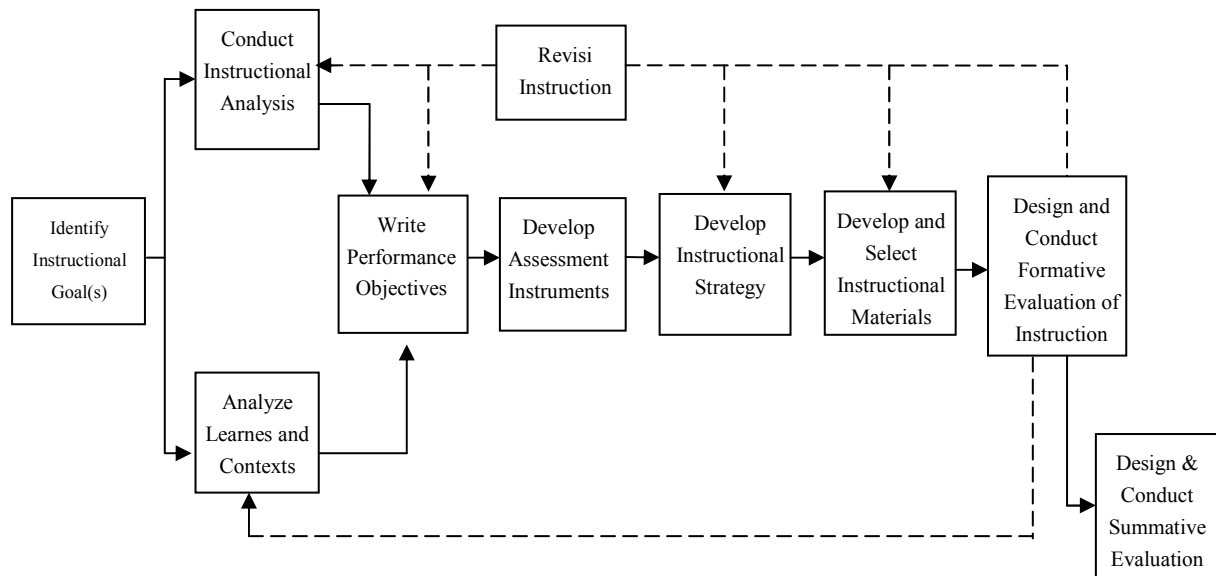


Figure 1. Dick and Carey Learning Design Model

The development of a mathematics device problem based learning was developed in accordance with the Dick & Carey development model procedure consisting of ten steps. Each step is always connected to the revision. After the module has been developed, it is validated by the experts and applied in the learning process in the first class, then the device effectiveness analysis is based on the indicator that becomes the device effectiveness criteria called trial I. Based on the experiment result I, analyzed the part of the device that needs to be revised or repaired again. The revised device is applied in the learning process in the second class, after which a device effectiveness analysis is performed based on the indicator that becomes the device effectiveness criteria called trial II. A good device to use in mathematics learning is a good quality math device. The high quality device criteria used in this study is valid and effective.

The validity instrument device uses the device validation sheet. The device validation sheet is used to measure the validity of the device. The validity of the device is useful to know whether the device is adequate to achieve the learning objectives. Device validity can be measured through expert analysis. The criteria states that a Problem based learning device has a good degree of validity, if at least the validity level achieved is a valid level. If the level of validity achievement below is valid, then it needs to be revised based on input (correction) of the experts. Furthermore, validation activities are performed again. And so on until the ideal device obtained from the size of validity.

The effectiveness of the device is used to find out whether the developed device can be used as expected to improve the students' mathematical problem solving ability. The device effectiveness instrument consists of: test to know the level of student's mathematical problem solving ability, observation sheet of active student activity level, teacher's ability observation sheet to manage the learning and questionnaire of student response to process and component of module usage. The criteria for determining the effectiveness of the mathematics device problem based learning is operational in the field (in the implementation of classroom learning) the four indicators of effectiveness aspects are met: 1) students' learning mastery of students' mathematical problem solving ability, ie at least 85% of students who follow learning can achieve more value than or equal to 2.67 or at least B<sup>-</sup>, 2) Achievement percentage of ideal time of assigned student activity, 4) Achievement of teachers' ability to manage learning at least well, 5) At least 80% of the subjects studied (for each trial) provide positive response to the activities and learning components.

### 3. Research Results

This research resulted some conclusions from research conducted based on problem formulation, that is device validity, device effectiveness, improvement of students' mathematical problem solving ability.

#### 3.1. Device validity

Device validity can be measured through expert analysis. Based on the results of expert analysis of mathematics device problem based learning obtained the average value of total validity is as shown in the following table

Table 1. Results Validity Device

Object / Aspect Assessed	Average Every Aspect	Average Value of Total Validity	Validation Level
a. Student Book	4.2	4,1	Valid
b. Lesson Plans	4.1		
c. Student Activity Sheet	4.0		

The following validity criteria:

- $1 \leq Va < 2$  : invalid
- $2 \leq Va < 3$  : less valid
- $3 \leq Va < 4$  : is quite valid
- $4 \leq Va < 5$  : valid

$Va = 5$  : very valid

Based on Table 1 above obtained the average total validity of each learning device is at intervals:  $4 \leq Va < 5$ .

Based on the criteria of validity it can be said that the learning device developed valid.

### 3.2. Effectiveness Device

The criteria for determining the effectiveness of mathematics device problem based learning in the field operation (in the implementation of classroom learning) consist of four indicators of effectiveness aspect. Based on the results of research on trial I, the results obtained from the four indicators are as follows:

1. Learning mastery to students' mathematical problem solving ability is classically, ie 66,67% of students who take the learning reaches a value of 2.67 or B<sup>-</sup>
2. Achievement percentage ideal time student activity is not in accordance with established
3. Achievement of the ability of teachers to manage learning is pretty good
4. 84,50% of the many subjects studied gave positive response to the activities and learning components.

Based on the results of research on trial II, the results obtained from the four indicators are as follows:

1. Learning mastery to students' mathematical problem solving ability is classically, ie 90% of students who take the learning reaches a value of 2.67 or B<sup>-</sup>
2. Achievement ideal percentage of time the student activity was in accordance with established
3. Achievement of the ability of teachers to manage learning is very good
4. 88,83% of the many subjects studied gave positive response to the activities and learning components.

From the result of trial II, it is known that the developed mathematics device has fulfilled the four indicators of effectiveness. With the application of mathematics device problem based learning, students are mastery is classical to problem solving ability, the ideal time percentage of student activity has been in accordance with established, the ability of teachers to manage the learning is very good and the number of students who give positive response to the activities and learning components have in accordance with the requirements that have been established from the indicators of effectiveness. In addition, the application of mathematics device problem based learning in the learning process can improve problem solving skills. Based on the research results and the above opinion, and supported by research and development conducted by Sinaga (2007), which is based on the results of expert validation and revisions have been done shows that, model development and learning tools in the form of Learning Implementation Plans (RPP), books teacher, student books, and LKS is valid and enforceable

### 3.3. Mathematical Problem Solving Ability

The level of mathematical problem solving ability was measured based on test results tested on the students in trial I and trial II. In the test I obtained the results of the test of mathematical problem solving ability with average value of 2.73. While in the trial II obtained the test results of mathematical problem solving ability with average value of 3.41. Based on the results of trial I and trial II, it is known that there is an increase in students' mathematical problem solving ability by using mathematics device problem based learning.

## 4. Conclusion

Based on the results of the research that has been obtained, it is concluded that:

- The mathematics device problem based learning developed is valid in improving students' mathematical problem solving ability with the validity level at the interval:  $4 \leq Va < 5$  with valid criteria
- The mathematics device problem based learning developed is effective in improving students' mathematical problem solving ability with the fulfillment of the five effectiveness indicators in trial II that is:
  - a. Students' learning mastery is classically that get a minimum value of B- to the mathematical problem solving ability reach 90%,
  - b. Achievement of the percentage of ideal time of student activity has been in accordance with the set,

- c. Achieving the ability of teachers to manage learning is good,
- d. 88,83% of the many subjects studied gave a positive response to the the activities and learning components.
- The improvement of students' mathematical problem solving ability in the application of mathematics device problem based learning is 0.68 with the average score of mathematical problem solving test results in test I obtained is 2.73. While in trial II obtained the average value of the test results of mathematical problem solving ability is 3.41.

## 5. Suggestion

Based on the conclusion of the above research, learning by using the model of PBM applied can improve students problem solving skills, for that researchers suggest several things as follows: 1) Teachers and prospective teachers in order to use PBM model learning tools as an alternative learning, students will be interested and enthusiasm to learn. 2) Learning tools with the application of PBM model developed this can be used as a reference to create a learning device with other materials in order to grow the ability to solve student problems both the level of the same or different education units. 3) Researchers suggest to readers and education practitioners to be able to conduct similar research, at the stage of dissemination is expected to disseminate learning tools more broadly, not only in field trial schools.

Based on the findings of the research, the researcher gives some suggestions, either to the reader, to the teacher or to the next researcher, that is:

1. The resulting modules need to be developed and used in other materials and other similar fields using problem based learning model
2. The test of mathematical problem solving ability should be frequently tested to the students so that the students become accustomed to solve the problems of mathematical problem solving and students are always reminded to solve the existing problems according to indicators of problem solving consisting of understanding, planning, and resolving.
3. Teachers should continue to motivate students to be active in learning and group discussions, explaining the importance of the material is learned and its relation to daily life by loading elements that are characteristic of the student's area or environment in the learning.

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